ARROW SPINE

ASTM are guidelines used for testing products. There three ASTM we use when it comes to arrows.

ASTM F1435-08. Standard Specification for Designation of the Balance Point Location for Archery Arrows (FOC)
ASTM F1889-05 Standard Guide for Straightness Measurement of Arrow Shafts.
ASTM F2031-05 Standard Test Method for Measurement of Arrow Shaft Static Spine (Stiffness)

In this paper, ASTM F1889-05 and F2031-05 are the two to be looked at with F2031-5 being the main topic.

F1889-05
Key factors.
2.1.2 standard total indicator reading (TIR), n—total indicator reading of arrow shaft straightness
4.1.2 Span Distance—The length of the span to be used for this test is 28 inches, with a length tolerance of +/-.125 inches.
4.1.3 Measurement Location—Arrow shafts measured for straightness are at the center of the span. The tolerance for the measurement location shall be equal to or better than +/-.250 inches.
4.1.4 Measurement Equipment—Measurements shall be taken with a non-contact laser type optical measurement device (note This test requires specialized test equipment. The test performed with a standard dial indicator, may or may not be accurate)

F2031-05
Key factors.
2.1.1 arrow spine—the deflection of the shaft, measured in inches, in a three-point load scenario where a specified mass applied to the midpoint of the arrow shaft supported at a fixed span.
2.1.2 spine around shaft variation—spine variation between four readings taken at 90° spacing around the shaft
4.1.1 Shaft Length— The shaft length to be used for standard spine measurement is the span distance plus 1 inch, to allow for axial travel during deflection.
4.1.2 Span Distance— The length of the span to be used for this test is 28 inches.

4.1.3 Measurement Location—Arrow shafts measured for the spine at the center of the span.
4.1.4 Measurement Equipment—Measurement equipment may involve the use of dial indicators, probe indicators, and laser gauging devices.
4.1.4.1 Mechanical Indicators—In the case of mechanical indicators, probe pressure should be limited to no more than 0.176 oz (5 g). ***(note the standard indicator being used varies in probe pressure. For an accurate measurement as possible, the spring is removed from the indicator. Calculations for correction are needed.)***
4.1.6 Test Description— The arrow shaft shall be deflected by a 1.94 lb. (880 g) weight at the center of the span. The weight may depend on or rest upon the shaft. The difference between the position of a given datum at the center of the shaft and the position of the same datum during deflection shall be the shaft spine value. The reading shall be taken within 30 s to prevent plastic deformation of the shaft material from affecting the readings.
5.2 Spine readings taken within a standard temperature range of 65 to 75°F (18 to 24°C). Because humidity is not a factor in arrow shaft measurement, a relative humidity range of 5 to 85 % is permissible.
5.4 Spine variation around the arrow shaft expressed as the standard spine around shaft variation > (x) where x is a value, in inches of the total spine variation, derived from four spine readings taken at locations evenly spaced 90° around the shaft.
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PNL TESTERS devised a method to compensate for the probe pressure being applied to the shaft while testing. This compensation is due to the standard in ASTM F2031-05 4.1.4.1. For the average person testing for their use, no corrections needed. When spine testing for yourself, consistency is the factor. PNL TESTERS provides data to manufactures as private data and or data to the public. The purpose of the correction is to make sure all data are given as accurately as possible.

Testing the arrow spine with a dial indicator applies probe pressure. Probe pressure can deviate depending on how much compression on indicator is applied. Removing the spring eliminates the varying probe pressure at different placements. Knowing the gram force (gf) of the probe is part of getting the correct data. The probe gf causes a deflection to a shaft. The amount varies depending on the spine. (For example, the indicator used by PNL TESTERS has a gf of 20.4. When testing a 250 spine AeroWeave arrow from Firenock, the indicator has a .0059 deflection. Blackeagle carnivore 350, the indicator probe applies .0078 deflection. Blackeagle x-impact 300 spine, probe applies .0068 deflection)

The standard for spine testing is setting the indicator on the shaft, then zero the indicator. An 880g weight is applied. The amount of deflection indicated on the indicator is the spine of the shaft. The zeroing the indicator after the probe applies pressure to the arrow removes this amount of deflection. By doing this, skewed data is now given — a mathematical calculation required at this point. The method devised by PNL TESTERS is taking the indicator reading, dividing this reading by the 880g weight applied. Gives you (x) the number is the deflection per g. Number (x) multiplied to the gf applied by the indicator. This number is (y). Due to the probe gf and the 880g being over the standard weight to be applied, a deduction required.
Doing this gives you a more accurate measurement. (example. Deflection reading of .310. This number divided by the 880g weight. You now have (x) .00035. The number (x) multiplied to

probe weight. For my indicator of 20.4 gives (y) .0072. Due to the amount of weight being over the standard, too much deflection given. Removing (y) from the reading of .310 gives an accurate spine reading of .302.) You can see this gives a reading of the arrow being weaker in the spine without any corrections given.
Another method people are doing is removing the amount of the probe weight from the 880g weight, giving a total weight of 880g with weight and indicator probe weight. Doing this DOES NOT eliminate the need for calculation corrections. When you apply the indicator probe to the arrow and then zero, you have removed the amount of deflection from the reading. (example, probe gf is 20.4. Removing this amount from the 880g weight leaves us a weight of 859.6. If the reading on the indicator is .310, we now divide the reading .310 by 859.6, giving us .00036. Multiplying this to the probe gf of 20.4, we now have .0073. The weight used is now lighter than the standard we must add. We would now take the .310 reading and add .0073, giving an arrow spine of .317. This method shows an arrow being stiffer in the spine without any corrections.

Why are these corrections necessary? For the average person, it is not; you are only looking for consistency. For PNL TESTERS or others, supplying data either to the public or manufacture is essential.

Manufactures list arrows as +/- in spine variance. (There is no standard). Most manufacturers, however, do use +/-.015, with some having +/-.020 and a select few being +/-.010.

Looking at an arrow with the manufacture of +/-.015 means a .300 can range from .285 to .315. If the arrow falls between these two points, the arrow is within specifications. Corrections in calculations are essential. When using the method devised by PNL TESTERS of removing the amount of probe weight from the 880g weight and we see an indicator reading of .315. Reading would indicate the arrow being at its max rating in the specification. We have seen without corrections applied. Skewed data is given. In this example, corrections made for the probe weight 20.4 and the 859.6 weight. The arrow spine is truly .322. The arrow .007 out of tolerance.

Providing data needs to be as accurate as possible. PNL TESTERS does its best to provide this type of data.